PATENT APPLICATION
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APPLICATION

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TITLE: **RECEPTION PERFORMANCE MEASURING APPARATUS FOR TELEVISION SIGNAL**

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TITLE OF THE INVENTION

Reception Performance Measuring Apparatus for Television Signal

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a reception performance measuring apparatus and, more particularly, to an apparatus for measuring reception performance of a TV (abbreviation for television) signal.

Description of the Background Art

Conventionally, a TV input signal is displayed in the form of an image on a screen via a tuner set by a CVBS (Composite Video Base-band Signal).

In measuring reception performance of TV signal by a tuner set, while changing conditions of each channel, appearance of noise on the screen is monitored by visual check for every condition being changed. As a result of such a monitoring, when noises do not appear within a prescribed period of time (for example, 20 msec), it is determined that the reception performance of the tuner set is right.

As described above, since conventional measurement of reception performance relied on manual measurement by an operator and hence entailed human errors, the efficiency was not satisfactory.

On the other hand, as a technique relating to measurement of reception of TV signal, an apparatus disclosed in Japanese Patent Laying-Open No. 2000-32365 is known. In this apparatus, a correction bit number outputted from an error rate detection circuit is inputted into a microcomputer control circuit, and divided by a reference bit number stored in the microcomputer control circuit by means of software, and then the result is outputted as an error rate signal.

Furthermore, Japanese Patent Laying-Open No. 2000-299665 discloses a technique of simultaneously measuring a reception level of electric wave and a bit error rate.

Furthermore, Japanese Patent Laying-Open No. 2002-94487 discloses a procedure of making a computer execute bit error measurement of transmission line.

The techniques disclosed in the above publications merely disclose measuring or detecting of bit error of digital data, and not suggest any techniques concerning measurement of reception performance of composite signal of TV signal.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an apparatus for measuring reception performance of a TV signal.

In order to achieve the above object, an apparatus for measuring performance of a TV (television) signal reception processing device according to an aspect of the present invention includes: a generating section for generating and outputting a digital signal; a noise section for generating a predetermined level of noise; a signal comparing section; and a determining section. The signal comparing section compares an analog TV signal corresponding to the digital signal outputted from the generating section, the analog TV signal being added with the noise generated by the noise generating section and subjected to reception processing by a reception processing device arranged in advance, with the digital signal outputted from the generating section between digital signals, and then the determining section determines the performance based on the comparison result by the signal comparing section.

According to the above reception performance measuring apparatus, the analog TV signal after being added with the noise generated by the noise section and subjected to reception processing by the reception processing device, and the original digital signal generated by the generating section are compared with each other between digital signals, and the performance is determined based on the comparison result. Therefore, it is possible to automatically determine and measure the performance of the reception processing device of a TV signal without human operations.

Preferably, the predetermined level is selected while being variably adjusted. Accordingly, it is possible to variably adjust the noise level to be generated and forcibly added for the purpose of measuring performance, so that the freedom of performance measurement, as well as accuracy of

performance measurement are improved.

Preferably, the generating section has a signal modulator which receives a digital signal corresponding to the supplied TV signal, modulates the received digital signal into an electric wave and outputs the same. In this manner, the digital signal can be converted to an analog TV signal, so that it is possible to measurement the digital signal more easily.

In the reception performance measuring apparatus, the signal comparing section preferably has a signal converting portion which receives the analog TV signal having subjected to reception processing and converts the received analog TV signal into a digital signal for comparison, and compares the digital signal generated by the generating section with the digital signal converted by the signal converting portion. Therefore, since comparison is made between digital signals, by using the comparison result, it is possible to determine the performance of the reception processing more accurately.

Preferably, the reception performance measuring apparatus further includes an outputting portion for outputting determination made by the determining section. Accordingly, the content of determination of performance measurement can be presented via the outputting portion, enabling the user to immediately know the result of the performance measurement by checking the content of the presentation.

Preferably, the predetermined level is outputted to the above outputting portion in addition to the determination. Therefore, in addition to the content of determination, the noise level currently applied is presented via the outputting portion, so that the user can also confirm anti-noise level regarding reception processing by the reception processing device which is an object to be measured.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic configuration diagram of a reception

performance measuring apparatus according to an embodiment of the present invention; and

Fig. 2 is a flowchart of processing procedure concerning measurement of reception performance.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A TV receiver receives a signal of a designated channel received via a tuner set, and displays an image on a screen based on a CVBS outputted therefrom. Therefore, in any tuner sets, the signal inputted will be outputted in the form of a CVBS. By converting the outputted CVBS into a LVDS (Low Voltage Differential Signal) of TS (Transport Stream) format, it is possible to detect an error rate by means of an error measuring device. By comparing the detected error rate with a reference rate and making a determination, reception performance of the tuner set can be measured. By making a personal computer execute this determination in accordance with a program stored in advance, it is possible to automatically measure the reception performance without human works. In measurement of reception performance, it is possible to measure the reception sensitivity, frequency difference and ghost noise and the like by appropriately combining measuring machines.

Fig. 1 shows a configuration of a reception performance measuring apparatus according to an embodiment of the present invention, and Fig. 2 shows a processing procedure concerning measurement of reception performance.

Now referring to Fig. 1, a reception performance measuring apparatus includes a TS generator 1 for generating a TS which is a picture signal digitized based on image date ID for measuring reception performance of a tuner set 5 which is an object to be measured, an error rate measuring device 2, a signal modulator 3 which receives the TS and transmits the received TS as an electric wave, a noise source 4 for generating various noises concerning TV signals, a LVDS converter 6 which receives a received CVBS and converts the CVBS to output a LVDS of digital signal, and a personal computer 7 to which an output portion 8 such as a screen is connected. Tuner set 5 receives (at its input) a digital signal,

and executes reception processing including tuning to send (output) the result.

In order to execute measurement of reception performance of tuner set 5, a flowchart shown in correspondence with a program stored in advance in personal computer 7 is provided by Fig. 2. The operation will be described with reference to Figs. 1 and 2. First, when TS generator 1 is activated by personal computer 7 (step S1), TS generator 1 generates a TS based on image date ID supplied thereto and outputs the TS to error rate measuring device 2. Image date ID may be supplied to TS generator 1 from personal computer 7. Also, TS generator 1 may generate a TS of prescribed pattern without using image date ID when it is actuated.

The TS passes through error rate measuring device 2 and is supplied to signal modulator 3. Personal computer 7 controls noise source 4 so that various noises of selected levels are generated (step S2).

Specifically, noise source 4 has a channel-up converter 41, a ghost generator 42 and a noise generator 43. Channel-up converter 41 adjusts the strength of input digital signal in accordance with the control by personal computer 7 and outputs the result to tuner set 5. By adjusting the signal strength or noise source 4, it is possible to artificially set the pattern of signal to be sent to tuner set 5 from a station. Ghost generator 42 generates a ghost noise of the level based on the control by personal computer 7, namely a white noise due to reflection, to give the ghost noise to tuner set 5. Noise generator 43 generates a white noise of the predetermined level based on the control by personal computer 7, to give the white noise to tuner set 5. Kinds of generated noises are not limited to the above. Although all kinds of noises are generated by noise source 4 in this description, the kind of noise to be generated based on the control by personal computer 7 may be selected from the above kinds.

In the manner as described above, it is possible to readily generate the digital TV signal to be sent to tuner set 5 from the TS. Further, since the level of the generated noise is variably adjusted and selected during measurement of performance, it is possible to gradually elevate or lower the level in the course of the measurement, and hence the freedom of

measurement increases. Also the level may be adjusted for every kind of noise.

Tuner set 5 executes reception processing including prescribed tuning on a digital signal containing noises, namely the input digital signal from channel-up converter 41 to which noise signals outputted from ghost generator 42 and noise generator 43 are added, and outputs a CVBS. Then LVDS converter 6 receives at its input the CVBS outputted having added with noises and subjected to reception processing as described above, converts it into a LVDS, and outputs the LVDS.

The LVDS outputted from LVDS converter 6 has the same format as that of the TS outputted from TS generator 1. Error rate measuring device 2 compares the TS inputted from TS generator 1 with the LVDS inputted from LVDS converter 6 while adjusting synchronicity of these signals by a known procedure, to detect a difference therebetween, and outputs the data of difference thus detected to personal computer 7. In this manner, since signal comparison is achieved by comparing the digital signal TS which is a basis of generating the analog TV signal with the digital signal LVDS (having the same format as TS) obtained by converting the analog TV signal after reception processing, it is possible to determine the performance of the reception processing described later more accurately by using such a comparison result.

Personal computer 7 receives at its input the supplied data of difference, and variably adjusts the noise level so as to control each portion of noise source 4 based on a difference between the inputted difference data and a predetermined level of BER (Bit Error Rate) (steps S3 to S5).

At this time, when the difference data represents the predetermined level of BER or less (YES in step S4), it is determined that the level of noise currently added to the signal is allowed for reception processing of tuner set 5, or is an allowable level for required performance, and personal computer 7 outputs the determination to output portion 8 (step S6). When the difference data is not less than the predetermined level of BER (No in step S4), it is determined that the level of noise currently added to the signal is not allowed for reception processing of tuner set 5, or is not an allowable

level for required performance, and personal computer 7 outputs the determination to output portion 8 and controls each portion of noise source 4 so that the level of noise added to the signal becomes lower (step S5). Thereafter, the processing returns to step S2, and the subsequent processes are executed in the similar manner. A level of noise currently selected may be outputted to output portion 8 together with the determination result.

Therefore, the user can also measure the anti-noise level concerning reception processing of tuner set 5 which is to be inspected by confirming the determination result or level of noise outputted to output portion 8.

By appropriately combining the kinds of noises generated by devices included in noise source 4, it is possible to measure a reception sensitivity representing an allowable signal strength which complies with the standard (required performance) of tuner set 5, a frequency difference representing an allowable frequency difference from frequency range for a specific cannel, a ghost nose and the like.

Although this description takes tuner set 5 as an example of inspection object, a TV set itself may be inspected. In addition, the standard of TV signal of reception signal may comply with either ATSC or OFDM (Orthogonal Frequency Division Multiplexing) without particularly limited.

According to the above-described configuration, since it is possible to automatically measure the reception performance, reading errors of spec value made by human at the time of visual measurement are avoided, and the measurement can be continued for a prolonged time.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.